



DEA 6660 Intelligent Environments for Everyday Interactions

Semester 2019—2020 Fall
Credit 3 units for DEA 6660
Lecture room HEB 2L32 Assembly Room
Time Mondays and Wednesdays 8:40—09:55
Course website <http://DEA6660IEEI.human.cornell.com>

Instructor Yixiao Wang, PhD
Instructor email yw697@cornell.edu
Office HEB 212
Office hour Friday 09:00 - 11:00 by appointment

Teaching Assistant (TA) Carlos Araujo de Aguiar
TA email Ca449@cornell.edu
Office 212 HEB - Human Ecology Building
Office hour Monday 13:30 - 15:30 by appointment

COURSE DESCRIPTION

The fast-developing AI and robotics technology have the potential to render our built environment more and more intelligent. What we used to see in sci-fi movies: emotive spaces, swarm architectures, partner-like offices, etc., could, at least partially, come to reality regarding today's technology. As human-centered researchers and environment designers, we have this exciting opportunity to explore how to design such intelligent environment for everyday human life. This class responds to this opportunity and challenge by designing basic architectural elements such as robot surfaces, which is then used to generate the design of "A Room Alive" informed by human-centered study results.

PREREQUISITE | ENROLLMENT

- 3 credits; letter grade only; no final exam; priority given to DEA and MAE students.
- Encouraged to enroll: Students from MAE, IS, CS, ECE, PSYCH, COGSCI, FSAD, ARCH, ART, COMM. All students from outside DEA require professor's permission.

LEARNING OBJECTIVES

- To develop the understanding of basic concepts in cybernetics, intelligent environment, architectural robotics, and embodied interactions.
- To develop the basic logic of research and apply the logic in the design-research of intelligent environment
- To hone the ability of creatively designing spatial artifacts while keeping human users in the loop.

LEARNING OUTCOMES

On successful completion of the course, students should be able to demonstrate:

- Understandings to the basic concepts in cybernetics, intelligent environment, architectural robotics, and embodied interactions.



- Abilities to plan and complete a self-motivated design-research project for designing intelligent environment.
- Abilities to think creatively, spatially, and develop design ideas with prototype iterations.
- Abilities to present creative designs using well-fabricated, beautiful final prototypes and skilled story-telling techniques.

COURSE DELIVERY AND LEARNING MODES

Each student group (2-3 people) should submit the following deliverables:

- Choose three of the following: Collage, sketches, scenario, story board or a gif video, to communicate your design concept, user group, and problem definitions
- A well-fabricated, beautiful prototype of your design. Better if it's working interactively (extra credits), but you could also VOZ your designed interactions in the video or demo.
- A Research through Design (RtD) report of your design-research process (could become a research paper if you guys do it well enough)
- A well-designed PPT with high quality images ("money shots")

Learning modes: readings, self-explorations, lectures, discussions, and group projects

- **Readings:** Each week we have two (or three) class readings that are crucial for students to get familiar with the session's topic. The chosen reading materials are a curated compilation of topics specific journal articles, book chapters, conference proceedings, and web articles. Students are expected to read the chosen reading materials.
- **Self-explorations:** Due to the nature of a graduate-level class, we have several self-exploration assignments for specific topics. These assignments will be presented, discussed, and exchanged in class so that everyone could be inspired by your works. About half of our in-class activities are studios with desk critiques, which are inherently guided self-explorations for design solutions.
- **Lectures & discussions:** Our lectures and in-class discussions are based on the required readings. Our discussions are designed to clarify concepts and share inspirations. lectures are designed to introduce innovative ideas, interesting topics, and promising research directions. Find what's exciting to you and dive into it through design-research iterations. Be excited to your project first, so that others could share your excitement.
- **Group projects:** there are basically two major projects (second one built upon the first one) in this class, which are all group projects. Find your partners wisely to compensate and inspire each other in the rest of the semester.

LEARNING RESOURCES

Text book (required for each student, digital or paper copy):

- Green, Keith Evan. Architectural robotics: ecosystems of bits, bytes, and biology. MIT Press, 2016.

Recommended books

- Dourish, Paul. Where the action is: the foundations of embodied interaction. MIT press, 2004.
- Hayles, N. Katherine. How we became posthuman: Virtual bodies in cybernetics, literature, and informatics. University of Chicago Press, 2008.

All other reading materials, tutorials, and videos (both required and recommended) are provided in digital format through web address and hyperlinks in course schedule on the course website.



COURSE CONTENTS AND SCHEDULE

WEEK # DATE	TOPIC CORE CONTENTS IN 1 SENTENCE	READINGS RED FONT ARTICLES & ASSIGNMENTS ARE REQUIRED
I Theoretical Foundation		
Week 01 09.02	Cybernetics & Intelligent Environments <i>Where is "intelligent environments" situated in the history of intellectual landscape?</i>	<ul style="list-style-type: none"> • "The architectural relevance of cybernetics" (Gordon Pask) • "Soft Architecture Machine: Chapter 4, Intelligent Environment" (Negroponte)
Week 02 09.09	Embodied Interactions & Architectural Robotics <i>Where is "intelligent environments" now and where it's going.</i>	<ul style="list-style-type: none"> • "Embodied Interactions" (Dourish, Paul) <i>Focus on the main idea.</i> • "Architectural Robotics" p. 1-21 (Keith Evan Green)
Week 03 09.16	Designing Intelligent Environments for Everyday Interactions <i>How to design intelligent environments for everyday interactions?</i>	<ul style="list-style-type: none"> • A Pattern Language Towns, Buildings, Construction preface to p. 1. (Alexander, C., Ishikawa, S., Silverstein, M. and Jacobson, M.) • "A Pattern-Based, Design Framework for Designing Collaborative Environments" (Yixiao Wang, Keith Evan Green) • Reference: "A survey of socially interactive robots" (Fong, T., Nourbakhsh I. and Dautenhahn, K.) p.147-150
Week 04 09.23	AI and Social Robotics <i>A review of the currently available AI techniques and social robot developments.</i>	<ul style="list-style-type: none"> • "A survey of socially interactive robots" p.155-158 (Fong, T., Nourbakhsh I. and Dautenhahn, K.) • Self-exploration: Find 3 examples of how latest AI technologies are applied to our daily lives and specify the human-computer interactions in these examples.
II Transformative Surfaces		
Week 05 09.30	Robot Surfaces <i>By design transformative surfaces, we could animate space.</i>	<ul style="list-style-type: none"> • Design and Characterization of a Novel Robotic Surface for Application to Compressed Physical Environments (Yixiao Wang, Chase Frazelle, Richa Sirohi, and Liheng Li) • Materiable: Rendering Dynamic Material Properties in Response to Direct Physical Touch with Shape Changing Interfaces (Hiroshi Ishii, et.al.) • Reference: <i>Design and Characterization of a Novel, Continuum-Robot Surface for the Human Environment</i> (Richa Sirohi, Yixiao Wang, Keith Evan Green)
Week 06 10.07	Surface Description <i>Explore and design the pattern, porosity, and spatiality of a surface with different materials.</i>	<ul style="list-style-type: none"> • TVM: https://theverymany.com/project-gallery • AA: https://www.aaschool.ac.uk/ • Minimal matters: https://wewanttorearn.wordpress.com/2019/02/03/triply-periodic-minimal-surfaces/ • Self-exploration: discover your own patterns and design how these patterns could be animated. Bring your own experiments to the class.
Week 07 10.14	Origami for Design <i>From sheet to form, develop spatial surfaces using folding techniques.</i>	<ul style="list-style-type: none"> • Folding Techniques for Designers from Sheet to Form (Paul Jackson) • Self-exploration: try some of the examples in the book and try to imagine how to actuate it. • Reference: "Origami folding: A structural engineering approach" (Schenk Mark and Simon D. Guest)



III A Room Alive

<p>Week 08 10.21</p>	<p>Emotive Environments <i>A room could manifest and evoke emotions as a “space agent.”</i></p>	<ul style="list-style-type: none"> • Watch the video: https://www.youtube.com/watch?v=8qv9KdKQU8A&t=3s • “Ballard Thousand Dreams of Stellavista” (JG Ballard) • Architectural Robotics pp. 129-170 (Keith Evan Green)
<p>Week 09 10.28</p>	<p>Soft and Reconfigurable Environments <i>A room could be soft and reconfigurable as if a living creature.</i></p>	<ul style="list-style-type: none"> • Muscle Body: http://www.interactivearchitecture.org/musclebody-kas-oosterhuis.html • Muscle Tower: https://www.youtube.com/watch?v=zoSnof-B4vo • Architectural Robotics pp. 23-68 (Keith Evan Green)
<p>Week 10 11.04</p>	<p>As a Partner <i>A room could be cooperative and partner with you through distributed elements.</i></p>	<ul style="list-style-type: none"> • Shared Cooperative Activity (Michael E. Bratman) • Architectural Robotics pp. 71-126 (Keith Evan Green) • Reference: Hyperbodies—Towards An E-motive Architecture p. 58-62 (Kas Oosterhuis)

IV User Studies

<p>Week 11 11.11</p>	<p>User Study and Evaluation <i>Get user feedback for your designed intelligent and interactive environment, using your prototype.</i></p>	<ul style="list-style-type: none"> • A Fieldwork of the Future with User Enactments (William Odom, et.al.) • User Experience Evaluation Methods: Current State and Development Needs (Arnold P.O.S. Vermeeren, et.al.) • Reference: Wizard of Oz Interfaces for Mixed Reality Applications (Steven Dow et.al.) • Reference: Co-creation and the new landscapes of design (Elizabeth B.-N. Sanders & Pieter Jan Stappers) • Reference: The potential role of the physical environment in fostering creativity (Janetta Mitchell McCoy & Gary W. Evans)
<p>Week 12 11.18</p>	<p>Report as Research through Design (RtD) <i>Get user feedback for your designed interactive environment, using your prototype.</i></p>	<ul style="list-style-type: none"> • Architectural Robotics pp. 103-107. (Keith Evan Green) • Research in Art and Design (Frayling, C) • Research through Design as a Method for Interaction Design Research in HCI (Zimmerman, J., Forlizzi, J. and Evenson, J)
<p>Week 13 11.25</p>	<p>The Art of Story-telling <i>How to give an effective oral presentation? How to organize your PPT?</i></p>	<ul style="list-style-type: none"> • Finding Your Scientific Voice: Using Theatre Techniques to Tell Your Science Story Ch. 1, 2, 3 (Melanie Dreyer-Lude and Itai Cohen)

V Ethics & Presentation

<p>Week 14 12.02</p>	<p>Ethics of Intelligent Environments <i>Design technologies for an ecosystem of “bits, bytes, and biology” in a value-sensitive way.</i></p>	<ul style="list-style-type: none"> • Moral Crumple Zones: Cautionary Tales in Human-Robot Interaction (Madeleine Clare Elish) • Value Sensitive Design, pp. 1-20 (Friedman Batya, Peter H. Kahn, and Alan Borning) • Reference: “No, The Experts Don’t Think Super Intelligent AI is a Threat to Humanity.” (Etzioni, Oren) • Reference: “Yes, We Are Worried About the Existential Risk of Artificial Intelligence.” (Dafoe Allan and Stuart Russell)
<p>Week 15 12.09</p>	<p>Final Presentation, Prototype Demo <i>Your final prototypes, interaction demos, and presentations are open to peer reviews.</i></p>	<ul style="list-style-type: none"> • No Reading Requirement



ASSESSMENT AND GRADING SCALE

For students, the course grade is composed by the four key elements: (1) attendance and class participation (discussions), (2) ideation submissions, (3) iteration & final prototype, (4) RtD report, and (5) final presentation. Extra credits will be rewarded to students whose prototype is fully functional. The points of each element are outlined in the table below.

Attendance & Participation	3 Ideation Submissions	Design Iterations	Final Prototypes	RtD report	Presentation & Demo	Total Points
15 pts	15 pts	25 pts	45 pts	15 pts	15 pts	130

The total points will be converted into a percentage and rounded off. Students will receive letter grades with pluses and minuses. Extra 10% will be added for a fully-functional interactive prototype.

A+	A	A-	B+	B	B-	C+	C	C-	D
4.3	4	3.7	3.3	3.0	2.7	2.3	2	1.7	1.3
95-100%	90-94%	85-89%	82-84%	78-81%	75-77%	72-74%	69-71%	65-68%	64-60%

GRADING CRITERION

Attendance and Participation

Attendance is mandatory, i.e., students are expected to attend all classes. Absence will be accepted only in exceptional circumstances and is to be requested in advance and in writing (yw697@cornell.edu). Repeated absence not previously agreed—exceeding three sessions—will result in a grade penalty at the end of the semester.

Class participation will be assessed based on the in-class discussions and the quality of self-exploration assignments. These are meant to support peer learning and teaching environment in class.

3 Ideation Submissions (individual submissions)

Each student should choose three of the following: Collage, sketches, scenario, story board or a gif video, to communicate your design concept, user group, and problem definitions. Remember that the logic of your problem definition is the foundation of your works. If you couldn't communicate your problem definition very clearly, you have already failed. So please write a short paragraph clearly communicating your problem definitions and design concepts clearly and submit this paragraph together with your 3 ideation submissions. The quality of each ideation submission worth 3 pts, and the logic of your problem definitions and design concepts worth 6 pts.

Design Iterations

Don't be afraid to make mistakes. Be bold and open to new design strategies. Try things that make you excited. As long as you keep trying meaningful and exciting things, and push the design progress forward, you will get full credits. Evaluated through desk-critics each time.

Criterion	Weighting	Criterion Descriptions
Try what's exciting to you.	10 pts	Not being intimidated by new design strategies. Try new design strategies as long as you see exciting designs ahead.
Push your design forward	15 pts	After trying some new strategies, you should focus on one strategy that interests you most and focus on developing your designs. I should see your iteration prototypes getting more and more specific physically, more and more sense-making logically.



Final Prototype

Final prototype elaborates your design concept, research, decisions, logics, and esthetics in a physical way. It could be the source of your “money shots” and “presentation opening videos.” Make it high quality, detailed enough, sense-making, and beautiful. **It will be shown at Final Demo and open to peer evaluations.**

Criterion	Weighting	Criterion Descriptions
High quality	15 pts	Nicely fabricated, carefully designed.
Clearly shows the interactions & intelligence	10 pts	You should be able to use your prototype easily VOZ your designed interactions and intelligence.
Clearly shows your major design decisions	10 pts	With enough many details presented in your prototype, you should be able to show your major design decisions together with brief oral explanations.
Esthetically beautiful	10 pts	Feel free to use light, color, transparency, water, reflection, etc. to make your model spatially intriguing and artistically inspiring.

Research through Design (RtD) Report

RtD is a very useful way to report your work not only as a design piece or art piece, but also as a formal research process. Please follow the examples and principles given in the article: *Research through Design as a Method for Interaction Design Research in HCI* (Zimmerman, J., Forlizzi, J. and Evenson, J) to do a RtD report. **As long as you follow it step by step, you will get full credits. Each step you miss, 2 pts will be deducted.** Well-documented design diary could be very helpful for RtD report, so please keep a design diary in design iterations and user study processes.

Final Presentation

An amazing “money shot” and intriguing “opening video” could be already half of the success for your presentation. The next thing you’ll need to focus on is a clear and thoughtful story-telling which is carefully designed. A good designer needs to be a great graphic communicator and oral communicator. **The quality of your ppt (including “money shot” and “opening video”) worth 10 pts, and your oral presentation worth 5 pts. Final presentations will be open to peer evaluations.**

Extra Credits

Fully-functional interactive prototype is encouraged but not required. **Extra 10 pts will be added to your final grade if you have a fully functional final prototype in of interactions and intelligence.**

KEY ACTIVITIES AND DATES

Activity & Assignment	Start Date	Due Date	Individual or Group
1 st Self-explorations	9/16	9/23	Individual
3 Ideation Submissions	9/02	9/30	Individual
2 nd Self-explorations	9/30	10/7	Individual
3 rd Self-explorations	10/7	10/14	Individual
Design Iterations	9/02	12/02	Group
Final Prototypes	It varies	12/09	Group
RtD Reports	It varies	12/02	Group
Final Presentations & Demos	It varies	12/09	Group
Design-research Diaries	It varies	Not Required	Group



COURSE POLICY

Consent for Research Participation

The user-study sessions in class and the two group projects will involve peer-to-peer participant studies, i.e., the students enrolled in the course will be recruited to conduct their own or other groups' studies. The studies utilize the design methods and tools taught normally used in user-centered studies such as user observation, interview, survey, heuristic evaluation, etc. (for an overview of the methods, refer to the section of course contents and schedule). The data will be collected using videos, audios, photographs, sketches, and/or written notes. Participants' profiles and project titles will never be attributed to file names and their meta-data. When the personal data of the participants is necessary for the process and outcome of the project (e.g., paper, poster, demo video, slide presentation, or other means of publication), the participants' responses will be anonymized. In addition, from the phase of data collection to the phase of project presentation, all data will be anonymized by replacing participants' names with nominal codes (e.g., participant A or member 1) and blurring participants' faces on photographs or videos. Both involving participants and participating in a study as a participant are an important facet of the course's learning experience as they contribute to practicing the design methods and tools, understanding and addressing end-users' wants and needs, and emphasizing with the end-users. However, some students might find this setup not acceptable or questionable, thus would have the inhibition to participate in certain studies. In this case, consult the instructor or the teaching assistant and let them know the decision in advance. Non-participation will not affect the student's end grade.

Publication Authorship

The student work may be further developed into academic publications for submission to conferences in the fields of design research and human-computer interaction. Examples are CHI, Nordi-CHI, TEI, DIS, DRS, ICED, IASDR, HRI, ICRA, Pervasive Healthcare, etc. The students who produced the work will have the authorship as the first authors and will be in charge of the publication process (e.g., submission and revision). The instructor and TA will be identified as the co-author (i.e., the last author) in recognition of their preparation and support in the work process.

Dissemination of Course Outcomes

Upon completion of the course, some of the course outcomes, including papers, posters, and demo-movies of the group projects will be made available on the course website under the approval of the students. The students who produced the work will be credited. This is to inform and inspire future DEA 6666 students. Perhaps, some students want to embargo their project outcomes for certain reasons. In this case, consult the instructor or the teaching assistant and let them know the decision in advance. Non-participation will not affect the student's end grade.

Diversity and Inclusion Statement

Cornell University and the course instructor committed to full inclusion in education for all persons. Services and reasonable accommodations are available to persons with temporary and permanent disabilities, to students with Deferred Action for Childhood Arrivals (DACA) or undocumented status, to students facing mental health or other personal challenges, and to students with other kinds of learning challenges. Please feel free to let the instructor know if there are circumstances affecting your ability to participate in class. Some resources that might be of use include:

- Office of Student Disability Services: <https://sds.cornell.edu/>
- Cornell Health CAPS (Counseling & Psychological Services): <https://health.cornell.edu/services/counselingpsychiatry>
- Undocumented/DACA Student support: In the Dean of Students office, contact Kevin Graham



- (Kevin.Graham@cornell.edu) and see the list of campus resources at <https://dos.cornell.edu/undocumented-dacasupport/> undergraduate-admissions- financial-aid.

This course follows the accommodations procedure of Cornell University policy. The request can be made through the student service services. To facilitate all necessary aids and services in a timely manner, it is recommended that students send an early notification to the instructor—within the first two weeks of classes, or at least two weeks before accommodations are expected to begin. For more details, check the procedure at <https://sds.cornell.edu>.

Academic Integrity

Absolute integrity is expected of every Cornell student in all academic undertakings. Integrity entails a firm adherence to a set of values, and the values most essential to an academic community are grounded on the concept of honesty with respect to the intellectual efforts of oneself and others. Academic integrity is expected not only in formal coursework situations, but in all University relationships and interactions connected to the educational process, including the use of University resources. While both students and faculty of Cornell assume the responsibility of maintaining and furthering these values, this document is concerned specifically with the conduct of students. A Cornell student's submission of work for academic credit indicates that the work is the student's own. All outside assistance should be acknowledged, and the student's academic position truthfully reported at all times. In addition, Cornell students have a right to expect academic integrity from each of their peers. The Cornell code of academic integrity is available at <https://cuinfo.cornell.edu/aic.cfm>.